AUTUMN AND WINTER FLOCKING BEHAVIOUR OF THE BROWN CREEPER (*FINSCHIA NOVAESEELANDIAE*)

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ABSTRACT

One hundred and ten flocks of the brown creeper (*Finschia novaeseelandiae*) were observed during autumn and winter 1974. Habitats studied were: podocarp-hardwood forest, kanuka-manuka scrub, beech forest and exotic forest.

Most flocks comprised five to eight brown creepers, with other insectivorous species present in about half the flocks observed. The silvereye (*Zosterops lateralis*) was most often present in habitats other than beech forest, whereas the yellowhead (*Mohoua ochrocephala*) occurred most frequently in beech forest.

Eight breeding calls were recognised, at least four of which maintain flock cohesion. Cohesion of flocks was highly variable, and occasionally sub-flocks formed. There were low levels of intraspecific and interspecific aggression, although brown creepers showed a marked mobbing response following disturbance.

Flocks of brown creepers fed primarily in the forest canopy. Leaves and bark provided the richest food sources. Movements during feeding consisted of energetic searching of the foliage, followed by a hop or short flight to another site.

Habitat utilisation is discussed with reference to flock movements, position in the habitat and feeding methods. Where appropriate, comparison of flocks from different habitats is made.

INTRODUCTION

Flock forming insectivorous species provide an opportunity to study the role of communication in behaviour patterns such as feeding, responses to predators and interactions with other species in the flock.

The brown creeper (*Finschia novaeseelandiae*) is an insectivorous species endemic to New Zealand. It is widespread and locally common in forest and scrub throughout the South Island and its outliers. It is absent from the North Island (Falla *et al.* 1966). Brown creepers form small flocks during autumn and winter. Other species may be present in these flocks. Little previous work has been published on the brown creeper, the literature being limited to physical descriptions and notes on breeding biology and habits.

In this study the flocking behaviour of the brown creeper was examined. Emphasis was placed on communication between

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individuals and the effects of intraspecific and interspecific interactions.

STUDY AREAS

During the autumn and winter (March to July) of 1974, flocks were watched in different localities in Otago and Southland (Fig. 1). The habitats were of four types:

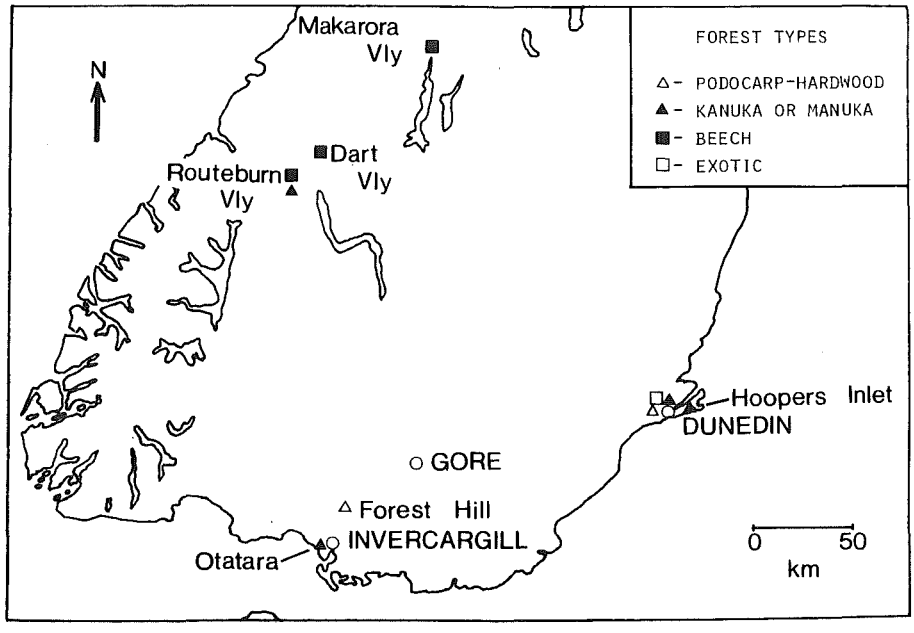

Fig. 1. Locations of study areas in Otago and Southland showing forest types.

1. Podocarp-hardwood forest

The major study area in this habitat is located near the Booth Road water treatment plant (c. 170°30'E, 45°50'S) on the north-west boundary of Dunedin city. This forest can be regarded as "cut-over", as some milling of podocarps occurred early this century. Principal species are rimu (*Dacrydium cupressinum*), totara (*Podocarpus* spp.), mahoe (*Melicytus ramiflorus*), lemonwood (*Pittosporum eugenioides*), fuchsia (*Fuchsia excorticata*), wineberry (*Aristotelia serrata*), and marbleleaf (*Carpodetus serratus*). These form a dense canopy 4 m to 7 m above ground level. Pepper (*Pseudowintera colorata*) and *Coprosma* spp. form an understorey shrub layer of varying density. Some observations were made at Forest Hill (168°26'E, 46°10'S) in Southland, where podocarp species are much more common than at Booth Road.

2. Kanuka (*Leptospermum ericoides*) - manuka (*L. scoparium*) forest

Brown creepers in this habitat were studied in many localiites, notably Ross Creek reservoir (near Dunedin) (c. 170°40'E, 45°50'S),

Otatara (near Invercargill) (c. 168°17'E, 46°26'S), and Hoopers Inlet (Otago Peninsula) (c. 170°40'E, 45°50'S). Three distinctive vegetation types were found:

(i) Kanuka-dominant forest: uniform closed canopy 8 m to 12 m high, hardwood understorey composed mainly of *Coprosma* spp., *Pseudopanax colensoi, Carpodetus* and *Aristotelia* (e.g. Ross Creek);

(ii) Scrub: patchy distribution of small trees or shrubs of *Leptospermum* spp. (e.g. Otatara, Dunedin environs);

(iii) Pure stands of kanuka or manuka 4 m - 8 m in height (e.g. Otatara, Hoopers Inlet).

3. Beech (*Nothofagus* spp.) forest.

Observations were made in beech forest in the Routeburn (c. 168°17'E, 44°44'S), Dart (c. 168°21'E, 44°42'S), and Makarora (c. 169°15'E, 44°13'S) valleys of Mount Aspiring National Park. Species present included silver beech (*Nothofagus menziesii*), mountain beech (*N. solandri* var. *cliffortioides*), and red beech (*N. fusca*), which formed a fairly dense non-uniform canopy between 10 m and 25 m in height. A sparse understorey layer comprised mainly *Pseudowintera, Coprosma* spp. and immature *Nothofagus* spp.

4. Exotic forest

This study area was near Dunedin (c. 170°27'E, 45°50'S). Species included *Pinus radiata* and douglas fir (*Pseudotsuga menziesii*), both of which formed a dense uniform canopy 18 m to 25 m high. Understorey species were absent except along forest margins.

METHODS

As virtually all flocks of brown creepers were located by calls the first task was to become familiar with the range of calls used. A tape recorder was used to record and analyse calls.

The number of individuals was recorded. Males and females could not be differentiated but juveniles were recognisable and their numbers were noted.

Other species associating with the flock were noted.

The following behaviour of flocks of birds was noted:

(a) Intraspecific interactions
(b) Interspecific interactions
(c) Responses of the flock to disturbances.

Information on habitat utilisation was collected, e.g. the rate of progress of flocks through the habitat, and the location and methods of foraging of flock members. The habitat was divided into a number of categories (see Gibb 1954) on the basis of height and part of foliage. The time spent at each station by the bird under observation was recorded. Observations on foraging methods were made incidentally with the gathering of other data.

RESULTS

GENERAL DESCRIPTION OF FLOCKS

Table 1 shows the monthly count of flocks observed, grouped into three size classes. A total of 110 flocks, containing 636 individuals, was observed. The largest flock, seen in podocarp-hardwood forest at Forest Hill, comprised 35 birds. On only one occasion was a lone brown creeper seen.

Identifiable juveniles were present in 51% of the flocks observed during March and April. However, as juveniles matured they became indistinguishable from adults.

TABLE 1. MONTHLY TOTALS OF ALL BROWN CREEPER FLOCKS OBSERVED, AND NUMBERS WITH RECOGNISABLE JUVENILES.

Month	March	April	May	June	July
Total number of flocks observed	25	30	15	16	24
Small flocks (1-4 birds)	11	11	1	7	10
Medium flocks (5-8 birds)	11	16	9	9	10
Large flocks (9 or more birds)	3	3	5	0	4
Number of flocks containing recognisable juveniles	13	15	4	2	2

Juveniles were found most often in flocks containing five or more individuals. During March and April, of 33 flocks of five or more birds, 24 (or 73%) contained recognisable juveniles, whereas in only four of 22 flocks (18%) containing four or less birds, were juveniles seen.

Approximately half the flocks observed contained more than one insectivorous species. In kanuka, podocarp-hardwood and exotic forests, the silvereye (*Zosterops lateralis*) was found most often, the grey warbler (*Gerygone igata*) and the fantail (*Rhipidura fuliginosa*) were seen commonly and the yellow-breasted tit (*Petroica macrocephala macrocephala*) was present occasionally. Brown creeper flocks observed in beech forest commonly contained the yellowhead (*Mohoua ochrocephala*) and chaffinch (*Fringila coelebs*). Occasionally the fantail, grey warbler, and silvereye were associated with these flocks.

The spacing between individuals within a flock was variable. In general, however, a flock of five to eight brown creepers usually occupied an area of up to 10 m^2 in or near the canopy of the forest. On many occasions, in all habitats, the birds seemed to be grouped into sub-flocks. For example an area of perhaps 0.4 ha - 0.8 ha might contain 20 brown creepers dispersed not evenly but in three medium-sized "sub-flocks". These groups were obviously in contact with each other, but sometimes remained distinct for up to 40 minutes.

TYPES OF CALLS

At least eight distinct non-breeding calls were recognised. Since most of these were given in easily identifiable social

situations it is convenient to name them contextually. This approach also provides a background from which the social functions of each call can be discussed.

The repertoire was as follows:

1. Juvenile food-begging call;
2. Social contact call;
3. Flocking call;
4. Flight call;
5. Alarm and mobbing call.

The functions of the remaining three are not clear:

6. Song;
7. Mini-song;
8. No. 8

The juvenile food-begging call was given by young, still dependent, brown creepers. It consisted of a repeated hoarse cheep emitted when the parent was in the vicinity or was coming with food.

The social contact call was a quiet "conversational twitter" given when birds were feeding close together in small, stationary or slow-moving groups. This call could be heard only if I was within about 7 m of the birds.

The following three calls were rather similar, varying mainly in intensity of performance.

The flocking call also appeared to help maintain contact between individuals in the flock. The call was of constant pitch but with considerable variation in intensity. It consisted of a hoarse "dee" which was repeated once as "dee dee", or many times to form a chatter.

The flight call was a short high-pitched call repeated during flight.

Alarm and mobbing calls occurred when flocks of brown creepers were disturbed. These calls consisted of a chorus of repeated loud cries similar to the flocking call but of greater intensity.

The remaining three calls were very distinctive and apart from (8) often used. No specific functions could be ascribed to them.

The song was a loud sequence of notes lasting three to four seconds ending in a trill which rose in pitch towards its end. Although large variation was apparent in songs from different localities, the basic form was easily recognisable. The specific function of this call in communication was uncertain but it did appear to be used to maintain contact over considerable distances.

The mini-song was a short, hoarse, but tuneful cry usually consisting of three notes, the last being prolonged.

(8) - a call heard on only a few occasions. It consisted of a series of high-pitched "chit" notes.

BEHAVIOUR

Feeding behaviour

Brown creepers spent most of their time foraging in the forest canopy. Although individual distances varied considerably, nearest neighbours in the flock were seldom closer than 0.2 m. Juveniles, however, sometimes huddled together on a branch.

Two calls were used primarily to maintain contact during feeding. The social contact call was given when individuals were relatively close together and foraging in stationary or slow-moving groups. The flocking call was typical of a larger, more active, relatively dispersed flock, where individuals were probably obscured from their neighbours. At any stage however, regardless of the size of flock, bursts of song and mini-song might be heard. A song sequence by one bird would often stimulate another to sing, both finishing the trill more or less in unison. This was shown convincingly when a tape-recording of the song was played to a small flock. On each of at least 10 playings, a song was elicited from a member of the flock. Both the flocking call and the song seemed important in communication between individuals some distance apart. On many occasions a call or song was heard which was an obvious response to a call from a bird elsewhere.

A marked difference was found between the frequency of calling or "background noise" of large flocks (nine or more birds) compared with smaller flocks of brown creepers. Small flocks were often silent for many minutes at a time, making observation difficult especially in dense vegetation, whereas the incessant calling of birds in larger flocks enabled them to be followed easily.

Family groups consisted of one to three juveniles with at least one adult in attendance. Periodically the adult uttered the flocking call while foraging to lead the young along. They responded with the juvenile food-begging call. Juveniles kept a close watch on their parents and if one appeared with food there was often an immediate rush to be first fed. Feather ruffling and clumsy attempts at foraging were characteristic of juveniles at this dependent stage.

Brown creepers were constantly on the move while foraging. The rate of progress of the flock depended mainly on the richness of the food supply in the immediate vicinity, and the density of the vegetation. Progress through the canopy was by series of hops and short flights (up to 10 m), with longer flights (up to 30 m) where the trees were less dense, or clumped. Extended flights were rarely made - the longest seen covered approximately 100 m in a beech forest clearing. The flight call given by birds embarking on these longer flights, initiated a following reaction from other flock members. Feeding was resumed when the new position was reached. The flight call was not given during short flights while feeding. There was no evidence to suggest that flocks were led by one particular bird. Flocks generally remained cohesive and although members might become separated for short periods, their constant calling ensured that contact was maintained.

There was no evidence of a dominance hierarchy within the flock and members appeared to be too absorbed with searching for prey to become involved in intraspecific conflicts. On only three occasions was a brown creeper seen to chase another. In each case the alarm and mobbing call was given by the chaser and the chased bird uttered a few submissive cheeps and made off. The whole sequence lasted only a few seconds. Competition for food from the adults caused fights and chases among the juveniles, but these, like chases among adults, were few and brief.

Response to Disturbance

Brown creeper flocks behaved distinctively when disturbed. Stimuli which elicited this behaviour included the sudden nearby appearance of a larger flying bird, an attack on a brown creeper by another bird, or an unfamiliar noise produced by an observer. The response, which varied considerably in duration and intensity, followed three stages:

1. An immediate chorus of alarm and mobbing calls from each member. If the intruder was still present the birds mobbed it.

2. A period of inspection of the intruder, with the birds still calling at high intensity, hopping excitedly about, and perhaps approaching within a few metres. Some rather animated feeding movements were made, perhaps in the nature of displacement activities. This stage might last up to 15 minutes, but was usually less than two minutes.

3. Birds gradually lost interest, quietened down and dispersed to resume feeding.

Flocks soon became used to the presence of an observer and after the initial response tapered off, close observation without further disturbance was possible. However, undue noise caused by the observer could produce a further mobbing response.

Intensity of response appeared to increase with flock size. Flocks of three or four birds sometimes completely ignored an intrusion, while the largest flocks seen (30-40 individuals) maintained a high level of noise and activity for up to 15 minutes following disturbance.

Two notable variations on the above sequence were found. Firstly, small disturbance responses often occurred despite the apparent absence of any stimuli. These "minor" disturbances sometimes involved the whole flock, but equally often would only concern some members while the remainder behaved indifferently. The second case occurred when the disturbing stimuli left the scene immediately, as for example, when a larger bird flew near the flock. A chorus of alarm and mobbing calls was usually made, but this would subside without the individuals mobbing up. Foraging was not appreciably interrupted by this type of disturbance.

Mixed-species flocks

Forty-seven percent of all flocks observed contained more than one insectivorous species. An insectivorous bird was considered part of the flock if it was associating with or moving near the brown creepers at some stage during the observation. Table 2 shows the occurrence of mixed-species flocks

TABLE 2. OCCURRENCE OF MIXED-SPECIES FLOCKS.

	Habitats other than beech			Beech		
Month	Total No. of flocks	No. of flocks containing only brown creepers	No. of mixed-species flocks	Total No. of flocks	No. of flocks containing only brown creepers	No. of mixed-species flocks
March	25	14	11 (44%)	0	0	0
April	23	10	13 (56%)	7	4	3 (43%)
May	10	7	3 (30%)	5	3	2 (40%)
June	15	5	10 (67%)	1	0	1 (100%)
July	16	7	9 (56%)	8	8	0
Totals	89	43	46 (52%)	21	15	6 (29%)

over the study period. Table 3 gives the composition of flocks on a monthly basis, with percentage occurrence of other species in flocks of brown creepers.

TABLE 3. PERCENTAGE OCCURRENCE OF OTHER SPECIES IN FLOCKS OF BROWN CREEPERS.

HABITATS OTHER THAN BEECH	March	April	May	June	July
Number of flocks	25	23	10	15	16
Other species:					
silvereye	16	52	20	13	44
grey warbler	8	0	10	7	19
fantail	20	17	10	13	6
yellow-breasted tit	8	0	0	0	6
BEECH					
Number of flocks	0	7	5	1	8
Other species:					
yellowhead	0	29	40	100	0
chaffinch	0	29	0	0	0
silvereye	0	0	20	0	0
grey warbler	0	14	20	0	0
fantail	0	14	20	0	0

Of 89 flocks observed in the combined habitats, 46 (52%) contained more than one species. In beech forest this figure was much lower (29%) and during July no mixed-species flocks were seen. Other species generally appeared to take little part in the normal activity of the brown creepers, especially in large flocks.

Commonly six brown creepers and a similar number of silvereyes, with possibly one grey warbler and one fantail nearby, comprised a flock. Though all birds were part of the same loosely associated flock, each species appeared to behave independently of the others. Only in alarm situations did the species react similarly with a chorus of calls and an increase in activity. The other species were usually indifferent to the flocking or flight calls of, and the "minor" disturbances amongst, the brown creepers. However, where a small number of brown creepers formed a flock with a greater number of silvereyes, the brown creepers were relatively quiet and seemed to rely on the noise and activity of the silvereyes to maintain their position in the flock. The creepers also responded to the silvereye's alarm calls.

Agonistic displays between brown creepers and other species were rare. Brown creepers were observed chasing fantails, silvereyes and grey warblers; and being chased by fantails, yellow-breasted tits, and bellbirds (*Anthornis melanura*). Chases usually occurred while feeding. Only once was any obvious provocation noted when a silvereye was chased after it had attempted to secure a grub held by a brown creeper.

HABITAT UTILISATION

General

Difficulty was experienced in using Gibb's (1954) method for analysis of the birds' feeding stations in podocarp-hardwood, beech and exotic forest because of the density of the canopies and extreme heights at which the flocks foraged.

However, in the kanuka forest with a uniform canopy (e.g. Hoopers Inlet), brown creepers foraged approximately 60% of the time on leaves, 30% on twigs (10 mm or less in diameter), and 10% on branches and trunks (diameter greater than 10 mm). Observations in other habitats suggested that more than 60% of time was spent searching among leaves, except in fuchsia, which was popular with brown creepers owing to the masses of loose papery bark hanging from trunk and branches. Mahoe was by far the most utilised tree in podocarp-hardwood forest. Lemonwood, marbleleaf and various coprosmas were also used.

All species of beech were searched, but where two or three species occurred together (e.g. the Routeburn Flats), red beech appeared to be favoured.

The richness of the leaf fauna is borne out by the high proportion of time the birds spent foraging in the canopy in all habitats but where a dense understorey layer occurred, birds were often seen less than 2 m from the ground.

Marginal areas of the habitat were utilised to a greater extent than mere random dispersion of flocks would suggest. One third of all flocks recorded were located in marginal areas. In beech forest especially, flocks first observed on margins would often remain close to the forest edge as they progressed.

Rate of progress of flocks was always variable. On one occasion a pair of brown creepers foraged in one small (4 m) dead specimen of *Pittosporum tenuifolium* for 15 minutes, while in a beech forest, a flock of six moved 250 m in 20 minutes. However, most values fell somewhere between these two extremes. There was no apparent relationship between flock size and rate of progress while foraging.

Nearly all flocks observed over periods up to one hour kept within an area of about one hectare. Very few movements extended for more than 60 m in any one direction. This meant that the birds back-tracked and often crossed and recrossed their previous path.

Food and feeding methods

The diet of the brown creeper consisted mainly of insect larvae, but fruits of *Coprosma propinqua, C. rotundifolia* and possibly *Pseudopanax crassifolium* were also taken. Insects were taken mainly from leaves but also from bark, especially that of kanuka, fuchsia and to a lesser extent of exotic trees. Dead branches were usually searched thoroughly, especially any broken tips.

In foraging a hop or short flight to a suitable place was followed by a brief glance around while making energetic probes into bark or among leaves. Brown creepers were very agile and "acrobatics" such as hanging upside-down from branches and twigs

and "walking" along the underside of branches while probing the bark, occurred during feeding. The birds often landed on flimsy twigs, where inspection of the leaves was carried out despite violent swinging movements. When a flock was feeding close together in this manner, a rain of twigs and leaves was sent down on the observer. Juveniles made clumsy attempts at foraging, and sometimes fell from the more precarious perches.

Larger prey (e.g. insect larvae) were usually prepared after capture. The prey was usually killed by being held in the beak and swung repeatedly against a branch. It was then dismembered with the beak while clamped between one foot and the branch.

Activity and the weather

Snow, rain, drizzle and extremes of temperature had no obvious effects on foraging habits, although birds appeared to be more active in warm, sunny weather. Strong winds had a marked effect on flock distribution, e.g. at Hoopers Inlet during very windy weather flocks were concentrated in sheltered areas.

DISCUSSION

Two main types of selection pressure may lead to the formation of flocks (Morse 1969, Murton *et al.* 1971, Vine 1971, Lazarus 1972). They:-

1. increase by social facilitation, an individual's chance of obtaining food,

and 2. lower predation via more efficient detection of predators. Also, members of a flock are less at risk after being seen by a predator, and flocks are often successful in driving off predators.

In forests, where visual signals are limited, an elaborate system of vocal communication is used to ensure flock cohesion (Crook 1969). Most insectivorous birds which flock have a wide repertoire of calls and the brown creeper is no exception. At least four distinct calls function specifically to ensure flock cohesion. The songs appeared to be important in long distance communication, especially between sub-flocks, and also during feeding or in response to disturbance.

Brown creepers in flocks showed marked synchronisation of activity. At any moment most members would be feeding, moving along, or responding to some disturbance. Crook (1961) suggested that synchrony of behaviour in small passerine flocks depended on two factors:

1. Social facilitation: the immediate copying of the behaviour of one individual by another. Although the activities of brown creepers were synchronised, the individual distance usually maintained in the flocks appeared too great to allow much close observation of one bird by another.

2. The following reaction: the tendency for one bird to follow others as they move about. The function of the following reaction is clear during movement of brown creeper flocks.

Individuals took wing in direct response to the sound of flight cries from others.

Synchrony of activities leads to flock cohesion. Brown creeper flocks appeared to be less cohesive than flocks of tits (Krebs *et al.* 1972) or mixed-species flocks of passerines (Morse 1969). On occasions flocks were discrete, with individual distances being rather small (up to 3 m). These groups were very cohesive, and remained intact for up to one hour. Other groups were relatively dispersed, with individuals obviously out of visual contact, although within audible range of each other. Still other flocks seemed to be composed of "sub-flocks" which sometimes united to form larger units. This wide variation in dispersal suggests either:

1. a weaker intraspecific flock organisation compared with other flocking species,

or 2. a degree of adaptability, where the size of flock may be adjusted to suit foraging conditions prevailing in the habitat. The low level of hostile interactions noted in brown creeper flocks, however, suggests a strong intraspecific group organisation.

Little evidence was noted for a dominance hierarchy within the flock. The low level of hostilities may indicate not the absence of a hierarchy, but that flock members were all familiar with each other, the status of each well established.

Mixed-species flocks present some difficulties in interpretation. Other studies have shown that mixed-species flocks may remain cohesive over long periods (Gibb 1960, Morse 1969). However, in my study, mixed flocks of brown creepers and silvereyes (and occasionally other species) were not united for long periods. Parties of brown creepers appeared to maintain their integrity within flocks of silvereyes. Apart from occasions where one species far outnumbered the other, no notice was taken of the social contact calls of the other species. This pattern of behaviour of mixed-species flocks could be regarded as merely the chance encounter of two different flocks, with an extended "overlap phase", but this would not take into account the interaction which does occur between the two species.

Brown creepers show a marked mobbing response to disturbances. Although no attacks by winged predators were observed, the mobbing response was given frequently when a larger unidentified bird flew near the flock. This is in contrast with mixed-species flocks studied by Morse (1969), who noted that members reacted to the appearance of a winged predator either by scattering into the undergrowth, or by staying motionless. A chorus of calls was given in each case. The incessant calling associated with mobbing in passerines is believed to confuse the predator which then has greater difficulty separating out an individual from the flock. Although brown creepers possess this mechanism for protection from attack, their constant activity and calling makes them much more obvious.

Other species present usually reacted in a similar manner to the brown creeper when disturbed. The occasional association of species that show few similarities to flock members could be a result of the increased alertness gained from hearing anti-predator calls.

Actual attacks on brown creepers seem very infrequent. During the five month study period, over 110 flocks were observed, but only once in beech forest near Makarora, were any potential predators, a pair of New Zealand falcons (*Falco novaeseelandiae*) seen in the vicinity of flocks. No attacks were noted in six hours observation of eight different flocks, within 400 m of the falcons' perching site. The presence of such a well developed alarm system, despite the very low incidence of predatory attacks suggests that the danger of winged predators to small birds was more severe in the immediate past than at present.

Frequent responses in the absence of a predator were noted. These included the "minor" disturbances, which sometimes involved only part of the flock, and in which other species did not participate. This suggests that reactions are set off by sudden novel stimuli. Responses made when no danger exists are wasteful in both time and energy. Unnecessary reactions would probably have been selected against if some protective advantage was not gained.

Habituation of flocks to the presence of observers shows that brown creepers are to some extent capable of adapting behaviour to circumstances. However, the birds are still aware of the intruder's presence, as unusual noise can produce further mobbing responses.

Data on utilisation of various parts of the habitat collected in kanuka forest, and observations from other forest types, suggest that brown creepers spend a greater proportion of time foraging on bark in kanuka, compared with other forests. The differences noted probably reflect the richness of the invertebrate fauna. Kanuka bark, which is rough and stringy, provides an ideal refuge for small invertebrates, whereas mahoe and beech species (except red beech) have comparatively smooth bark (at least near the canopy). In beech and exotic forest where undergrowth was sparse or absent, the flocks were restricted almost entirely to the canopy. Although no census of numbers was taken, the brown creepers appeared to be much more numerous in podocarp-hardwood forest, and especially so in kanuka forest.

Data on the movements of large flocks have to be regarded with some reservation because of the difficulty of observing such flocks without evoking the mobbing response. A flock of about 40 birds at Forest Hill, following the initial response did not disperse for 15 minutes, which introduced a considerable bias to the data. Observations of smaller flocks where the human influence was minimal showed that the typical pattern of movement involved frequent changes of direction which kept the flock within a relatively small area. This is consistent with the regular patrol of a home range, as noted with tits by Hinde (1952), and suggests that it is advantageous for birds to keep to familiar ground.

Brown creepers favoured marginal areas of all habitats. These data were biased, however, as flocks were more readily located when in a margin compared with in the forest interior. Favouring of marginal areas could be due to the greater amount of foliage (and hence food present) and the increased light intensity which facilitates the location of small food items.

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